

**REMARKS/ARGUMENTS**

Upon entry of this amendment, claim 4 will be canceled without prejudice or disclaimer of the subject matter recited therein, claims 1 and 7 will be amended, and claims 12-23 will be added, whereby claims 1-3 and 5-23 will be pending. Claims 1, 7, 12, 13, 14 and 17 are independent claims.

The amendments to the claims are supported by Applicants' originally filed disclosure, and therefore should not be considered to constitute new matter. For example, the recitation of claims 1 and 7 "wherein said bioactive glass has a glass transition temperature of 790°C or lower" is supported at least in originally presented claim 4, page 8, line 11 and Fig. 1 of the specification.

The recitation in claim 12 finds support at least at page 3, lines 14-16, and page 8, lines 21-24 of the specification.

Claims 13-14 find support at least in originally presented claims 2 and 3.

Claims 15-16 find support at least in originally presented claims 5-6, and also find support at least at page 3, lines 23-26 of the specification.

The recitation of claim 17 finds support at least at page 3, lines 13-26; and page 8, lines 21-24 of the description.

The recitation of claims 18 and 19 of "wherein said bioactive glass is substantially free from  $P_2O_5$ " finds support in at least in originally presented claims 8 and 9, respectively, and at page 3, lines 26-27 of the specification.

The recitation of claim 20 of "A sintered calcium phosphate glass comprising the bioactive glass recited in claim 12 as a sintering aid" finds support in at least originally presented claim 10, and page 3, line 28 to page 4, line 1 of the specification.

The recitation of claim 21 of "The sintered calcium phosphate glass according to claim 20, wherein said sintered calcium phosphate glass contains a calcium phosphate comprising a hydroxyapatite, a carbonated apatite or tricalcium phosphate." Finds supports in at least currently amended claim 11, and at page 4, lines 2-4 of the specification.

The recitations of claims 22 and 23 are supported by at least page 5, beginning at line 24.

Reconsideration and allowance of the application are respectfully requested.

### **Consideration Of Information Disclosure Statements**

Applicants express appreciation for the inclusion with the Office Action of initialed copies of the Forms PTO-1449, whereby the Examiner's consideration of the Information Disclosure Statements filed October 15, 2003, December 15, 2003 and December 6, 2004 is of record.

Applicants further note that a Third Supplemental Information Disclosure Statement is being filed on even date herewith. The Examiner is respectfully requested to confirm consideration of this Third Supplemental Information Disclosure Statement by initialing the Form PTO-1449 submitted therewith, and forwarding the initialed form with the next communication from the Patent and Trademark Office.

**Claim Of Priority**

Applicants express appreciation for the acknowledgement of the claim of foreign priority as well as receipt of the certified copies of the priority applications.

**Response To 35 U.S.C. 112, Second Paragraph, Rejection**

In response to the rejection of claims 10 and 11 under 35 U.S.C. 112, second paragraph, as being indefinite, Applicants respectfully submit the following.

In response, Applicants respectfully submit that these claims are definite. However, in an attempt to advance prosecution of the application, Applicants have amended claim 11 to even more clearly denote Applicants' invention.

Accordingly, this ground of rejection should be withdrawn.

**Response To Rejections**

(a) Rejection of claims 1,4-6, 8, 10 and 11 under 35 U.S.C. 102 (b) as being anticipated by Pfeil et al. (hereinafter "Pfeil"), U.S. Patent No. 4,135,935

Initially, Applicants note that claim 4 has been canceled and its subject matter has been included in independent claim 1. Therefore, independent claim 1 is directed to a bioactive glass having a composition substantially comprising 30 to 60 mol % of CaO, 40 to 70 mol % of SiO<sub>2</sub>, and 20 mol % or less of Na<sub>2</sub>O, said bioactive glass having a glass transition temperature of 790°C or lower.

As described in Applicants' specification, at pages 3 and 5-7, the present invention has been achieved based on the finding that when a CaO-SiO<sub>2</sub>-based bioactive glass is

mixed with powders of tricalcium phosphate, such as hydroxyapatite, in the sintering process as a sintering aid, it promotes the sintering of the powders of tricalcium phosphate showing a softening behavior in a temperature region between the glass transition temperature  $T_g$  and the crystallization initiation temperature  $T_{c0}$  of the bioactive glass, thereby providing a sintered calcium phosphate glass excellent in biocompatibility and mechanical strength. Also, the bioactive glass of the present invention can deposit  $\beta$ -wollastonite crystals (of calcium silicate) having a needle-like structure at a crystallization temperature (see page 3, lines 7-13; page 5, lines 10-17; page 5, line 24 to page 6, line 4; page 6, line 18 to page 7, line 1; and Fig. 1).

Thus, Applicants' bioactive glass, when used as a sintering aid, amongst other features, renders it possible to deposit  $\beta$ -wollastonite crystals having a needle-like structure at a crystallization temperature so as to provide a sintered calcium phosphate glass excellent in biocompatibility and mechanical strength.

In contrast to the various aspects of Applicants' bioactive glass, Pfeil discloses a ground glass of the following composition, in weight percent: 46.2 % of  $\text{SiO}_2$ , 25.5% of  $\text{Ca}_3(\text{PO}_4)_2$ , 20.2% of  $\text{CaO}$ , 2.9% of  $\text{MgO}$ , 4.8% of  $\text{Na}_2\text{O}$ , and 0.4% of  $\text{K}_2\text{O}$  (see column 7, lines 55-65), which corresponds to a composition, in mol %: 56.3 % of  $\text{SiO}_2$ , 6.0% of  $\text{Ca}_3(\text{PO}_4)_2$ , 26.4% of  $\text{CaO}$ , 5.39% of  $\text{MgO}$ , 5.7% of  $\text{Na}_2\text{O}$ , and 0.4% of  $\text{K}_2\text{O}$ . Thus, the glass composition described in Pfeil's Example falls outside the bioactive glass composition having 30 to 60 mol % of  $\text{CaO}$ , 40 to 70 mol % of  $\text{SiO}_2$ , and 20 mol % or less of  $\text{Na}_2\text{O}$  recited in the amended claim 1 of the present application.

As is clear from claim 1 of Pfeil, Pfeil discloses a glass of the following composition as a second sintering material B, in weight %: about 20% to about 60% of  $\text{SiO}_2$ , about 5% to about 40% of  $\text{P}_2\text{O}_5$ , about 2.7% to about 20% of  $\text{Na}_2\text{O}$ , about 0.4% to about 20% of  $\text{K}_2\text{O}$ , about 2.9% to about 30% of  $\text{MgO}$  and about 5% to about 40% of  $\text{CaO}$ , which contains not only many other compounds not recited in the amended claim 1 of the present application but also  $\text{P}_2\text{O}_5$  as an essential component (see claim 1; column 3, lines 39-61 of Pfeil).

Although Pfeil describes a composite material produced by sintering together a first sintering material A, such as hydroxyapatite, and a second starting material B composed of an inorganic multi-component system, such as a glass ceramic material which may contain at least one modifier, i.e., at least one radioactive compound, for instance,  $\text{ThO}_2$  or at least one compound which is capable of foam formation in the sintered material, for instance, a carbonate (see abstract, lines 1-6; column 1, line 68 to column 2, line 3; and column 4, lines 51-57 of Pfeil). Pfeil does not specifically teach or suggest any composite material exhibiting high biocompatibility. For example, Pfeil does not provide any examination of the bioactive glass with respect to cell attachment, cell proliferation and alkaline phosphatase activity as described in Example 9 of the present application. Nor does Pfeil provide excellent mechanical strength and sinterability as in the present invention.

Further, Pfeil is silent with respect to a glass transition temperature of  $790^\circ\text{C}$  or lower. Moreover, Pfeil is silent regarding the generation of  $\beta$ -wollastonite crystals at a crystallization temperature, such as recited in claim 6.

Therefore, Pfeil does not teach Applicants' recited bioactive glass composition as recited in Applicants' claim 1 or as further defined in dependent claims 5, 6, 8, 10 and 11. Accordingly, this ground of rejection should be withdrawn.

(b) Rejection of claims 1-11 under 35 U.S.C. 102 (b) as being anticipated by or, in the alternative, under 35 U.S.C. 103 (a) as obvious over Fujiu et al. (hereinafter "Fujii"), U.S. Patent No. 4,708,652

Fujii discloses an apatite composite ceramic obtained by reaction-sintering at a sintering temperature of 700-1100°C at a pressure of at least atmospheric pressure a powder mixture of a synthetic hydroxyapatite (A) and a biological active glass (B) containing fluoride ions and having a crystallization temperature below the sintering temperature in a weight ratio of A/B ranging from 60/40 to 30/70. The reaction sintered material of Fujii is disclosed to have excellent biological affinity and high mechanical strength. Fujii also discloses that the biological active glass (B) is selected from the scope of the following composition (disclosed in U.S. Patent No. 4,437,192): 35-60 mol % of SiO<sub>2</sub>, 0-15 mole % of B<sub>2</sub>O<sub>3</sub>, 10-30 mol % of Na<sub>2</sub>O, 5-40 mol % of CaO, 0-1 mol % of TiO<sub>2</sub>, 0-15 mol % of P<sub>2</sub>O<sub>5</sub>, 0-20 mol% of K<sub>2</sub>O, 0-10 mol% of Li<sub>2</sub>O, 0-5 mol % of MgO, 0-8 mol % of (Al<sub>2</sub>O<sub>3</sub> + ZrO<sub>2</sub> ± Nb<sub>2</sub>O<sub>5</sub>), 0-8 mol % of (La<sub>2</sub>O<sub>3</sub> + Ta<sub>2</sub>O<sub>5</sub> + Y<sub>2</sub>O<sub>3</sub>) and 5-20 mol % of F<sub>2</sub> (see Abstract, claims 1 and 4, and column 3, lines 35 et seq. of Fujii).

In contrast to the disclosure of Fujii, Applicants' independent claim 1 is directed to a bioactive glass having a composition substantially comprising 30 to 60 mol % of CaO, 40 to 70 mol % of SiO<sub>2</sub>, and 20 mol % or less of Na<sub>2</sub>O, said bioactive glass having a glass transition temperature of 790°C or lower. Moreover, Applicants' independent claim 7 is

directed to a bioactive glass having a composition substantially comprising 30 to 60 mol % of CaO, 40 to 70 mol % of SiO<sub>2</sub>, and at least one of Na<sub>2</sub>O, CaF<sub>2</sub> and B<sub>2</sub>O<sub>3</sub>, Na<sub>2</sub>O being 20 mol % or less, CaF<sub>2</sub> being 1 mol %, and B<sub>2</sub>O<sub>3</sub> being 5 mol % or less, said bioactive glass having a glass transition temperature of 790°C or lower.

Fujiu is silent with respect to a bioactive glass having a glass transition temperature of 790°C or lower. Moreover, Fujiu does not discuss a bioactive glass having cell attachment, cell proliferation and alkaline phosphatase activity as described in Example 9 of the present application.

Moreover, Fujiu discloses broad ranges of components, but does not sufficiently envisage to anticipate or render obvious the compositions recited in Applicants' claims. There is absolutely no motivation in Fujiu to pick and choose from the various ranges disclosed therein to arrive at Applicants' claimed subject matter. This is especially apparent from a review of the specific examples of Fujiu, such as disclosed in U.S. Patent No. 4,437,192 referenced at column 3, lines 35-53 of Fujiu.

The dependent claims add further patentable features that are also not sufficiently envisaged or rendered obvious by Fujiu.

Accordingly, this ground of rejection should be withdrawn.

(c) Rejection of claims 1, 2 and 4-9 under 35 U.S.C. § 102 (b) based on Suh et al (U.S. Patent 5,634,956)

Suh discloses a glass ceramic for use as a biomaterial comprising CaO 34.6 to 54.6%, SiO<sub>2</sub> 24.2 to 44.8 %, P<sub>2</sub>O<sub>5</sub> 0 to 8.0 %, CaF<sub>2</sub> 0.1 to 1.0 % and MgO 1.0 to 10.0 % by weight, the glass ceramic having a primary crystalline phase which is wollastonite

(CaO, SiO<sub>2</sub>) and a secondary apatite crystalline phase which can be an apatite without adding the glass ceramic as such to calcium phosphate (see Abstract; column 2, lines 10-15; column 3, lines 38-40 and lines 46-49 (EXAMPLES I and 2) of Suh).

However, Suh fails to teach or suggest any feature such that the glass ceramic as such might have a function to promote the sintering in the process of sintering calcium phosphate, even when the glass thereof was added to calcium phosphate.

Suh does not teach any glass ceramic containing Na<sub>2</sub>O as an element in the glass ceramic thereof, and therefore claim 1 cannot be anticipated.

Moreover, Suh is silent with respect to a bioactive glass having a glass transition temperature of 790°C or lower as recited in claims 1 and 7. Thus, while Suh discloses compositions that have CaO and SiO<sub>2</sub> in the bioactive glass that overlap with Applicants' recited ranges, Suh is silent with respect to any bioactive glass having a glass transition temperature of 790°C or lower. The rejection does not indicate any reasoning for considering the glass transition temperature recited in Applicants' originally presented claim 4, and presently included in claims 1 and 7, as being within any composition disclosed in Suh.

According, Suh does not anticipate independent claims 1 or 7, and the rejection should be withdrawn with respect to these independent claims and the claims dependent therefrom.

(d) Rejection of claims 1-9 under 35 U.S.C. § 102 (b) or in the alternative, under 35 U.S.C. §103 (a) based on Japanese document 6 1-205637 (JP'637)



JP'637 discloses the composition of a crystal glass comprising at least 90 wt% or more comprising 40-60 wt% SiO<sub>2</sub>, 30-45 wt% CaO, 1-17 wt% MgO, and 10 wt% or less of impurities and a minute wollastonite (CaO.SiO<sub>2</sub>) crystals dispersed in the crystal glass as at least one of the deposited crystals (see English abstract of JP'637 and Table I in JP'637 attached to the Action), which is different from the amended claims 1 and 7 of the present application. The composition of JP '637 is structure, such as in containing MgO as an essential element in the CaO-SiO<sub>2</sub>-based bioactive glass, so as not to provide the characteristics recited in Applicants' claims.

For example, in contrast to JP'637, the subject matter recited in Applicants' claims 1 and 7 includes a bioactive glass that has a glass transition temperature of 790°C or lower. However, JP'637 is silent with respect to a bioactive glass having a glass transition temperature of 790°C or lower. Also, the composition of JP '637 is not disclosed as being suitable for an examination of the bioactive glass with respect to cell attachment, cell proliferation and alkaline phosphatase activity as described in Example 9 of the present application.

Also, JP'637 fails to teach or suggest any feature such that the glass ceramic as such might have a function to promote the sintering in the process sintering calcium phosphate, even when the glass thereof were added to calcium phosphate.

Therefore, those skilled in the art referring to JP'637, which discloses a bioactive glass different from the present invention, and does not teach or suggest any bioactive glass having a glass transition temperature of 790°C or lower as well as having a function

to promote the sintering in the process sintering calcium phosphate in the presence thereof, would not be motivated to arrive at Applicants' bioactive glass.

Accordingly, the anticipation and obviousness rejections should be withdrawn.

(e) Rejection of claims 1-11 under the judicially created doctrine of obviousness-type double patenting over claims 1-11 of copending Application No. 10/962,557.

In response to this ground of rejection, Applicants note that Application No. 10/962,557 is pending, and an Office Action has not been received in that application. Therefore, Applicants respectfully submit that, in conformance with Patent and Trademark Office procedure and in view of the fact that Application No. 10/962,557 is not a patent, the present application can be sent to issue.

Still further, Applicants respectfully request the Examiner to reconsider the double patenting rejection based upon the merits in view of the presently pending claims.

### **Newly-Added Claims**

The newly-added claims are patentable over the prior art of record, because the prior art does not teach or suggest, as recited in independent claim 12, a bioactive glass having a composition consisting essentially of 30 to 60 mol % of CaO, 40 to 70 mol % of SiO<sub>2</sub>, and 0.1-5 mol % Na<sub>2</sub>O. Moreover, the prior art of record does not teach or suggest, as recited in independent claim 13, a bioactive glass having a composition consisting essentially of 30 to 60 mol % of CaO, 40 to 70 mol % of SiO<sub>2</sub>, 0.1-5 mol % Na<sub>2</sub>O, and

CaF<sub>2</sub>. Still further, the prior art of record does not teach or suggest, as recited in independent claim 14, a bioactive glass having a composition consisting essentially of 30 to 60 mol % of CaO, 40 to 70 mol % of SiO<sub>2</sub>, 0.1-5 mol % Na<sub>2</sub>O, and B<sub>2</sub>O<sub>3</sub>. Still further, the prior art of record does not teach or suggest, as recited in independent claim 17, a bioactive glass having a composition consisting essentially of 30 to 60 mol % of CaO, 40 to 70 mol % of SiO<sub>2</sub>, and at least one of Na<sub>2</sub>O, CaF<sub>2</sub> and B<sub>2</sub>O<sub>3</sub>, Na<sub>2</sub>O being 0.1 to 5 mol %, CaF<sub>2</sub> being 1 mol %, and B<sub>2</sub>O<sub>3</sub> being 5 mol % or less.

Dependent claim 15 further patentably defines claim 12 by reciting that a difference between its glass transition temperature and its crystallization initiation temperature is 80°C or more.

Dependent claim 16 further patentably defines claim 12 by reciting that the bioactive glass generates a β-wollastonite crystal at a crystallization temperature.

Dependent claims 18 and 19 further patentably define claims 12 and 17, respectively, by reciting that the bioactive glass is substantially free from P<sub>2</sub>O<sub>5</sub>.

Applicants respectfully submit that one having ordinary skill in the art would understand the scope of substantially free from P<sub>2</sub>O<sub>5</sub>, especially in view of Applicants' disclosure.

Dependent claim 20 further patentably defines Applicants' invention by being directed to a sintered calcium phosphate glass comprising the bioactive glass recited in claim 12 as a sintering aid.

Dependent claim 21 further patentably defines claim 20 by reciting that the sintered calcium phosphate glass contains a calcium phosphate comprising a hydroxyapatite, a carbonated apatite or tricalcium phosphate.

Dependent claims 22 and 23 further patentably define claims 1 and 7, respectively, by reciting that the bioactive glass comprises CaO and SiO<sub>2</sub> in approximately equal molar ratios.

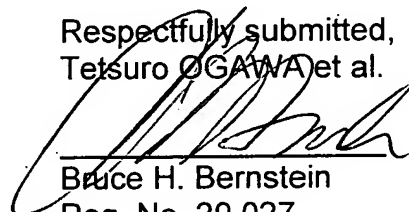
### CONCLUSION

In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw the rejections of record, and allow each of the pending claims.

Applicants therefore respectfully request that an early indication of allowance of the application be indicated by the mailing of the Notices of Allowance and Allowability.

Should the Examiner have any questions regarding this application, the Examiner is invited to contact the undersigned at the below-listed telephone number.

Respectfully submitted,  
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